PORTLAND HARBOR RI/FS

Round 3A FIELD SAMPLING PLAN STORMWATER SAMPLING

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1.0 INTRODUCTION

This ~~stormwater~~ Field Sampling Plan (FSP) presents the approach and procedures to implement stormwater sampling activities in early 2007 for the Remedial Investigation and ~~/~~Feasibility Study (RI/FS) of the Portland Harbor Superfund Site (Site). ~~The RI/FS project is currently conducting Round 3A of sampling for various purposes in the river, which will extend well into 2007. Therefore, this stormwater sampling is considered part of the Round 3A sampling.~~ This FSP describes the field sampling and laboratory analysis procedures to accomplish the following types of stormwater data collection:

- ~~Stormwater~~ Whole-water chemistry, total suspended solids (TSS), and associated conventionals
- ~~Stormwater~~ In-line ~~suspended~~ sediment chemistry and associated conventionals.

The field study sampling procedures, methods, and analyses for stormwater are described in this document. This FSP is a companion document to the Rationale for Round 3A Stormwater FSP under separate cover, which describes the reasoning behind the overall approach.

The RI/FS project is currently conducting Round 3A of sampling for various purposes in the river, which will extend well into 2007. Therefore, this stormwater sampling is considered part of the Round 3A sampling.

1.1 BACKGROUND AND CONTEXT

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Surface water contaminants are suspected to contribute to fish tissue burdens (and related risks) in the Site study area. The importance of various sources of surface water chemicals, particularly stormwater, is not well understood. This lack of understanding could make it difficult to accurately determine sediment (and water) preliminary remediation goals (PRGs) that are intended to minimize fish tissue related risks for the site. Thus, it is necessary to determine the relative contribution of stormwater (as compared to other sources) to surface water concentrations of selected contaminants.

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Additionally, stormwater discharges have the potential to contribute to recontamination of sediments near outfalls (and/or potentially Site-wide for some chemicals) following cleanup when the discharge contains settleable solids with associated contaminants. The potential for this outcome must be assessed at an FS-appropriate level of detail to understand the general extent and need for stormwater source controls.

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To understand the relative contribution of stormwater contaminants to fish tissue burdens and predict whether sediments would recontaminate at levels above PRGs eventually set

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for the site, estimates of stormwater loads are needed for inputs to estimation tools and models (i.e., Food-web model and Fate & Transport Model *or cite reference*).

Existing stormwater quality data for the Site study area are sporadic and relatively limited (Integral et al. 2004). Consequently, estimation of stormwater loads to the river based on existing data or literature values would be highly uncertain. Site-specific stormwater sampling is needed to support stormwater chemical loading estimates for input into the fate and transport model and other estimation tools that will be used to assess the data to understand the relative contribution of stormwater contaminants to fish tissue burdens and predict whether sediments would recontaminate at levels above PRGs eventually set for the site.

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Since the draft RI report is due in spring 2008 this information needs to be collected in the 2006/2007 wet-weather season to prevent further slippage of the RI/FS schedule. Additional information may be collected by individual sites to supplement this effort and included in the final RI report.

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As a result of the lack of information on the stormwater pathway, a Stormwater Technical Team (Team) comprised of representatives of the Environmental Protection Agency (EPA), Oregon Department of Environmental Quality (DEQ), and Lower Willamette Group (LWG) was established in November 2006. The recommendations of the Team (Koch et al., December 2006) were presented to the Portland Harbor Managers (also comprised of representatives of EPA, DEQ and LWG) in December 2006 and are the basis of this FSP.

1.2 SAMPLING PURPOSE AND OBJECTIVES

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The purpose of this sampling and analysis effort is to evaluate the quality of stormwater discharges on sediment quality. The result of this effort will be used in an overall evaluation of source loadings to the Site study area to determine if 1) stormwater discharges are contributing to the ecological and human health risks; and 2) recontamination of the sediments following cleanup would be expected based on the current stormwater discharge rates.

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The objectives of this sampling and analysis plan are:

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- To provide an early indication of any water or sediment quality problems within the Site study area associated with stormwater discharges.
- Identify areas where sources of contaminants to the Site study area may be significant (e.g., contributing to risk or recontamination of the Site).
- Understand stormwater contribution to in-river fish tissue chemical burdens.

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1.3 SUMMARY STORMWATER SAMPLING APPROACH

This FSP describes the approach for measuring the concentrations of contaminants in stormwater and for obtaining stormwater flow data at 31 select locations in the Site to meet the above objectives. These data will be used, in conjunction with estimation and evaluation tools described below, to assess the nature and extent of chemical loading from stormwater discharges to the site. In summary, the sampling approach involves:

1. Flow-weighted composite water samples from three design storm events (see Section 5.1.2.1) including whole water for organic compound analyses and filtered/unfiltered pairs for metals analyses.
2. One additional set of grab stormwater samples at 10 of the 31 sampling locations for sampling of filtered/unfiltered pairs and analysis of selected organic compounds.
3. Sediment trap deployment and sampling for a minimum duration of 3 months.
4. Continuous flow monitoring at each sampling site for the duration of the sampling effort.

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1.4 DOCUMENT ORGANIZATION

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The remaining sections of this document describe the sampling plan and field procedures that will be used to collect stormwater and sediment samples:

- Section 2 describes the sampling design.
- Section 3 summarizes stormwater sample collection, processing, and measurement procedures for stormwater samples, sediment samples, and stormwater flows.
- Section 4 describes the sampling implementation and schedule including contingency procedures that may be employed to collect data.
- Section 5 summarizes how the data will be reported.
- Section 6 provides references.

Detailed standard operating procedures (SOPs) for sampling and flow measurements are provided in appendices. The appendices also contain a Chain of Custody SOP, field sampling forms, and health and safety procedures and are organized as follows:

- Appendix A Stormwater Composite Sampling SOP

- Appendix B Stormwater Grab Sampling SOP
- Appendix C-1 Sediment Trap Sampling SOP
- Appendix C-2 Stormwater Filtering for Sediment Collection (Back Up Procedure)
- Appendix D Flow Meter Measurements
- Appendix E Field Forms
- Appendix F Chain of Custody SOP
- Appendix G Laboratory Protocol for Extraction and Analysis of Large Volume Water Samples
- Appendix H Confined Space Health and Safety Plan Addendum

1.5 DATA QUALITY OBJECTIVES

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The LWG will adhere to their Standard Operating Procedures (SOPs) and accepted analytical methods for collection, preservation, transportation, storage, and analysis of samples in an effort to limit sources of bias. The SOPs applicable to this sampling program are provided in Appendices A, B, C, and F. An overview of the procedures for sample collection and processing are presented in Section 3.0. The analytical methods to be used are presented in Tables 2-5a and 2-5b. Every attempt will be made to achieve the reporting limit goals identified in Tables 2-5a and 2-5b.

1.5.1 Precision

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Precision is a measure of scatter in the data due to random error from sampling and analytical procedures. Precision will be measured using relative percent difference (RPD) on laboratory duplicates and matrix spike duplicates.

RPD is calculated by:

RPD = 100 * (Sample Concentration – Duplicate Concentration) ÷Average Concentration

Acceptable limits of laboratory duplicates and Matrix Spike Duplicates (MSD) are listed in Table 4-2. The frequency of laboratory duplicates and Matrix Spike Duplicates is listed in Table ?. These tests will allow the LWG to estimate the precision of the data set. Specific details regarding field and laboratory quality control samples are discussed in Section 3.8, including number of control and duplicate samples, which will be performed on each batch.

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1.5.2 Bias

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Bias is a measure of the difference between the parameter result and the true value due to systematic errors. Possible sources of systematic errors are collection, sample instability (physical/chemical), interferences, calibration, contamination, etc.

Bias associated with sample matrix will be measured using the percent recovery (%R) on laboratory control samples, matrix spikes recoveries and surrogate recoveries. Matrix spikes may provide an estimate of bias for the entire analytical procedure. The acceptable recoveries for Laboratory Control Samples (LCS) and Matrix Spikes for the parameters to be analyzed are listed in Table 4-2. The frequency of LCS, Matrix spike and surrogate samples is listed in Table ?.

Percent Recovery is calculated by:

%R = 100 * (Measured concentration ÷ true concentration).

Matrix Spike recovery is calculated by:

%R = 100 * (Spiked Sample Result – Sample Result) ÷ (Spike Added).

Surrogate Recovery is calculated by:

%R = 100 * (Measured Concentration ÷ Amount Added)

Bias associated with contamination will be assessed by analysis of equipment rinsate blanks and laboratory method blanks. The equipment rinsate blank is a measure of field contamination whereas the method blank is a measure of laboratory contamination. When a commonly found contaminant (which are the phthalate compounds, lead and zinc) is found in the blank, the sample concentration must be at least 10 times the concentration of the blank in order to be considered a valid number. The common phthalate compounds are listed in Tables 2-6a and 2-6b. When an uncommon contaminant is found in the blank, the sample concentration must be at least 5 times the concentration of the blank in order to be considered a valid number. Blanks that show common or uncommon contamination result in data being qualified (estimated) up to 10 or 5 times the blank value.

The frequency of method blank samples is listed in Table ?. The frequency and location of the equipment rinsate blank samples are described in Section 3.8. A field duplicate sample for sediment traps will be deployed at two locations and analyzed with each sediment trap batch to provide an estimate of overall variability in the sediment data.

Certified Reference Materials (CRM) will be analyzed to monitor performance of the analytical systems. Information regarding the CRMs for this project are included in Appendix ?.

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1.5.3 Representativeness

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1.5.3.1 Whole Water

This project will measure the quality of storm flows and sediment associated with storm flows discharging to the waterway. With regard to stormwater, representativeness is achieved by selecting sample locations, methods and times so that the data describes the characteristics of stormwater runoff over the range of land use conditions in the drainage basins, the varying hydrologic conditions within an individual storm event (i.e., rising and falling portions of the hydrograph), and a representative cross-section of storm types. Additional details regarding representativeness of sample location, collection of storm flows, in-line sediments, and the criteria used for sampling are presented in Sections 3.4 and 3.5.

Representativeness of Individual Storm Events. Whole-water samples will be flow-weighted composite samples representing the range of discharge conditions during the sampling event, including where possible the rising and falling portions of the runoff hydrograph.

Representativeness of Storm Types. Storm Events are variable in nature by runoff volume, flow rate, antecedent rainfall, and season. This variability will be evaluated by comparing the magnitude and intensity of the runoff hydrographs, where samples were collected on the hydrographs, time between storm events, and time of year the samples were collected to determine whether a representative range of storm types was included in the monitoring program.

The LWG will evaluate data, progress, sampling methodology, and sample locations on an ongoing basis as data is analyzed and the project is implemented. While it is anticipated that a sufficient number of samples will be collected, the number of samples will be reevaluated at the end of the sampling event. Through the course of this sampling effort, the LWG may request modifications to the SAP.

1.5.3.2 Sediment Traps

Sediment Traps are useful monitoring tools to help identify ongoing sources in the drainage basins; however, their utility in developing quantitative stormwater loads remains problematic. There are several concerns regarding the representativeness of sediment trap samples for characterizing large drainage basins with multiple sources.

For the most part, the physical design, placement and appearance of in-line sediment traps is fixed. However, the physical characteristics of each location vary from site to site, not only from manhole to manhole, but also from basin to basin. For example, a sediment trap installed in a 72-inch pipe with a large base flow is positioned in a manner which prevents collection of base flow solids, but allows collection of “storm” water solids as the water level in the pipe rises. The sampler may be collecting sample during the early portion of the hydrograph; while in contrast, a sediment trap installed in a 18-inch pipe with minimal base flow may begin collecting a sample closer to the peak of the hydrograph. Because there exists a minimum height at which a sample can be collected,

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some sediment traps may not be sampling during smaller storms which are being sampled at other locations.

Another concern regarding sediment traps is that this sampling method captures only the particulate fraction of the stormwater but provides little information on dissolved constituents. For constituents that are primarily transported in the dissolved phase, sediment traps may not be an appropriate montitoring tool.

There is no information on potential sampling biases that may occur during sediment trapping, but considering the perturbations in the flow field that the bottle creates, certain grain size fractions in the suspended load could be preferentially trapped.

Finally, there is a stron tendency to inappropriately compare sediemtn concentrations in pipeline traps to sediment quality criteria. However, such comparisons do not account for mixing and chemical exchange in the receiving water, and these processes can significantly reduce the chemical burden on the sediment particles.

The LWG will evaluate data, progress, sampling and analytical methodology, design of sample apparatus (bottle size, installation) and sample locations on an ongoing basis as data is analyzed and the project is implemented. Through the course of this sampling effort, the LWG may request modifications to the SAP.

1.5.4 Completeness and Comparability

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The completeness and usability of the data will be maximized by using proven sampling techniques, packaging samples for transport to avoid breakage, and timely processing at the laboratory. The analytical requirements in sample volumes to achieve goals will be met to assure acceptable data. Where possible, excess sample will be acrchived until the laboratory results can be reviewed by the project manager. The goal for generation of usable data will be 100%.

For comparability, the analytical chemistry methods were selected to be appropriate for comparison with other data being used for the RI/FS. It is realized that if reporting limits differ, it will limit the ability to make direct comparisons and may limit future cleanup decisions. It is further realized that modifications to sampling locations can also limit the ability to make comparisons. In addition, one field replicate (the sediment trap samples only and if there is enough sample available) will be collected and analyzed from two outfall locations (see Section 3.8). If a field replicate is not feasible, a field duplicate will be collected.

2.0 SAMPLING DESIGN

The Rationale for Stormwater FSP describes the general approach and rationale for the overall study to support RI/FS objectives described in this FSP. This section describes some the overall sampling design based on that rationale.

2.1 SAMPLE~~,~~ LOCATIONS, TYPES, ~~AND~~ NUMBERS, AND ANALYSES

Tables 2-1 and 2-2 summarize the proposed stormwater sampling locations, types, numbers, and analyses. Sample locations are presented in Figures 2-1a, 2-1b, and 2-1c. Tables 2-3 and 2-4 summarize~~s~~ the priority order of sampling of analytes for each sample type and the approximate sample volumes that will be needed for these analyses. Table 2-5 provides the laboratories and methods that will be used for sample analysis. Table 2-6 presents the analytes, analytical concentration goals, method detection limits, and method report limits. The analytical concentration goals achievable with these sample volumes are discussed further in ~~more below~~Section 2.4.

All sampling equipment will be deployed at locations that are as close to the point of discharge (for outfall locations) or the last junction[1] associated with the land area of interest (for the land use based locations). In all cases, equipment will be placed at elevations sufficient to minimize the potential for river water to back up to the sample location and compromise flow data quality, the integrity of the sediment traps and collection of quality stormwater samples.

Commented [NU3]: I moved this paragraph from discussion under Flow Measurements to here because it seemed applicable to all equipment, not just flow equipment.

Three types of measurements will be conducted each station. Each measurement type is discussed further in the following sections.

2.1.1 ~~Stormwater~~ Whole-Water ~~Composite~~ Samples~~.~~

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Stormwater Composite Samples. Flow-weighted composite samples of three storm events from each location will be collected to obtain Event Mean Concentrations (EMCs) of constituents of interest. Flow-weighted, whole water (unfiltered) sample aliquots will be collected over the course of the storm event with Isco 6712 automatic samplers. These whole water samples will be collected by the sampling teams, identified in Section 4, and transported to the LWG Field Laboratory. At the LWG Field Laboratory, sampler performance will be evaluated and the water from the individual sample bottles will be combined and mixed in a single container. Whole water samples for organic compounds, and unfiltered/filtered water pairs will be prepared for metals and total organic carbon (TOC)/dissolved organic carbon (DOC) by the sampling teams from the combined composite sample. Samples will also be prepared for analysis of TSS concentrations. Each sample will be analyzed for the chemicals shown in Tables 2-2 and 2-3. In

Commented [NU4]: Where will samplers be installed? Good description given for sediment traps, but lacking here.

[1] The term “junction” refers to any accessible location where two or more pipes are joined by a structure such as a manhole. This may include locations where drainage from surface runoff also enters the junction, such as catch basins that connect two or more pipes.

addition, the priority order and list of chemicals analyzed will vary somewhat between locations as shown in Table 2-4a for reasons discussed in the R~~r~~ationale document.

Storm Event Criteria.

The target storm conditions for sampling are: storms predicted to produce more than 0.2 inches rainfall over a minimum of a 3-hour period, not to exceed approximately 2.25 inches in a 24 hour period (equivalent to the 2-year event), and to have been preceded by at least a 24-hour dry period (less than 0.1 inches rainfall). National Oceanic and Atmospheric Administration (NOAA) storm predictions will generally be used in the evaluation of storms potentially meeting these criteria (http://www.wrh.noaa.gov/forecasts/graphical/sectors/pqrWeek.php#tabs).

For each sampling location, drainage basins will be evaluated for basin size and runoff characteristics to facilitate calculation of expected discharge flows for a variety of storm conditions meeting the storm criteria. Samplers will be programmed to collect aliquots of stormwater following the discharge of the calculated "trigger volume" for each storm event. The objective is to collect~~get~~ a composite sample that represents aliquots collected into seven 1.8-liter bottles over the entire storm hydrograph (the eighth bottle in the sampler will be used for quality assurance/quality control [QA/QC]). However, this is only an approximate guideline that will be considered in the above evaluation of expected discharge flows and may be modified at one or more sampling locations. If storm flows exceed expected volumes, the sampling period will be concluded when the sample bottles are full and thus in some cases, the falling limb of the storm hydrograph may not be sampled in its entirety.

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Stormwater Grab Samples. One~~During one storm event,~~ discrete stormwater "grab" sample~~s~~ will be collected from 10 locations where it is most likely that organics would be detected in water samples. Because the purpose of the grab samples is to collect chemical dissolved phase/suspended sediment partitioning rather than loading data, samples will be collected during storm periods expected to have higher ~~COI~~ chemical concentrations (e.g., first flush or rising limb), to increase the likelihood of detecting low level ~~COIs~~chemicals. While all samples will be analyzed for TOC/DOC~~ constituents~~, the sampling locations were selected based on general knowledge of site uses and potential sources. Table 2-4a describes the locations where stormwater grab sampling will ~~take place~~occur.

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The sample teams will collect the required quantity of water and transport it to the LWG Field Laboratory, where one aliquot will be filtered and distributed appropriately to bottles for laboratory analyses and a second aliquot will be distributed directly to bottles. Sample will be analyzed for the organic compounds shown in Table 2-4a and TSS. Target s~~S~~torm conditions for grab sampling are the same as for composite sampling described above, with grab samples taken sometime in the rising limb of the hydrograph of a continuous storm meeting the above requirements.

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2.1.2 Sediment Samples~~.~~

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Sediment traps will be installed at each sampling location immediately upstream of the outfall discharge and downstream of the automatic sampler. Figure 2-2 presents a photograph of a prototype of the sediment trap that will be deployed. The sediment trap will be placed adjacent to the outlet of the stormwater facility with the opening of the collection bottle at the same elevation as the invert of the outlet. Some sampling locations may require the use of sandbags or structural modifications to generate flow conditions conducive to sediment trap sampling. These sediment traps will be deployed at each location for a minimum target period of 3 months during the wet-weather period.

Sediment traps will be inspected at a minimum on a monthly basis. When inspected, if the collection bottle is more than half full of sediments, the bottle will be capped with screw closures, removed from the mounting brackets, packaged and placed on ice in coolers for transport to the laboratory (see Table 2-5) to be ~~collected and~~ archived. ~~and a~~An empty collection bottle will then be ~~returned to~~placed in the trap. If the collection bottle is less than one third full at the first monthly inspection, options for repositioning or relocating the equipment or adding additional traps to obtain a higher~~better~~ collection rate will be considered.

Sediments will be collected and archived throughout the 3-month deployment period. At the end of the deployment period, all sediments for each location will be combined and homogenized and sampled for analyses in the priority order shown in Tables 2-3 and 2-~~.~~4b as the available sediment volume allows.

In Tables 2-3 and 2-4b, analytes are ranked in priority order in the event that any collected sample size is insufficient to run all analyses. The Rationale for the Stormwater FSP describes the reasoning for this priority order.~~,~~ Grain size is the last priority analyte~~. I~~ because it is unlikely that large enough sample volume~~s~~ for grain size analysis will be obtained at most locations and it is more important to obtain information on chemistry.

Also, due to physical constraints, it may be impossible to deploy sediment traps at some locations. Contingency procedures in the event of this problem are discussed more in Section 4.3. One possible contingency measure is to pump and actively filter sediments from large volumes of stormwater at some sites. This contingency technique is also described in Section 3.5.2.

2.1.3 Flow Measurements

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~~.~~ Isco Model 750 Area Velocity flow modules will be used in conjunction with the Isco automatic samplers to allow the collection of flow-weighted composites at each sampling location. The flow modules will also continuously record flow data for the duration of sediment trap deployment.

~~All sampling equipment will be deployed at locations that are as close to the point of discharge (for outfall locations) or the last junction[2] associated with the land area of interest (for the land use based locations). In all cases, equipment will be placed at elevations sufficient to minimize the potential for river water to back up to the sample location and compromise flow data quality, the integrity of the sediment traps and collection of true stormwater samples.~~

2.4 SAMPLE ANALYSIS

Stormwater and sediment samples will be analyzed as described below. Table 2-5 summarizes the analytes and methods of analysis for each analyte group for each sample type (sediment and stormwater).

2.4.1 Whole Water Samples

The stormwater samples will be analyzed for pH, conductivity, turbidity, and temperature in the field. Stormwater samples will be analyzed at selected chemical laboratories for conventionals, metals, and organic parameters as summarized i~~o~~n Table 2-5b. It is anticipated that sufficient sample volume (as noted in Table 2-3) will be collected during each stormwater event to conduct all analyses listed in Table 2-5b. The specific analytes for each parameter group and the analyte concentration goals (ACGs) are included on Table 2-6b. Table 2-2 shows the number of natural samples and identifies the QA/QC samples for each sampling event. A Quality Assurance Project Plan (QAPP) ~~Addendum for the Round 2A QAPP (Integral and Windward 2004)~~ for this investigation is presented as Addendum 8 to the Round 2A QAPP (Integral and Windward 2004) under separate cover. The QAPP Addendum summarizes the analytical program and provides details on the laboratory methods, QA procedures, and QA/QC requirements.

2.4.2 In-line Sediment Samples

The sediment samples will be analyzed at selected chemical laboratories for conventionals, metals, and organic parameters as summarized i~~o~~n Table 2-5a. The analytes are listed in the priority for analysis in Table 2-3. If sufficient mass (as shown on Table 2-3) is not available to complete all analyses, the analyses will be conducted by the laboratory in the priority order identified in this table. Any additional mass available will be used for laboratory quality control analyses (matrix spike samples, laboratory duplicate samples, matrix spike duplicate samples). The specific analytes for each parameter group and the ACGs are included on Table 2-6a. Table 2-2 shows the number

Commented [NU8]: I added this to make it clear that this in in-line stormwater sediments and not in-river sediments.

Commented [NU9]: It is likely that sample cleanup procedures will need to be used for sediment trap sample analysis. This section should discuss those procedures or reference where they are located.

[2] The term "junction" refers to any accessible location where two or more pipes are joined by a structure such as a manhole. This may include locations where drainage from surface runoff also enters the junction, such as catch basins that connect two or more pipes.

of natural samples and identifies the QA/QC samples for each sampling event. A QAPP ~~Addendum for the Round 2A QAPP (Integral and Windward 2004)~~ for this investigation is presented as Addendum 8 for the Round 2A QAPP (Integral and Windward 2004) under separate cover. The QAPP Addendum summarizes the analytical program and provides details on the laboratory methods, QA procedures, and QA/QC requirements.

3.0 SAMPLE COLLECTION AND PROCESSING PROCEDURES

This~~e following~~ section~~s~~ describes the sampling procedures, record keeping, sample handling, storage, and field quality control procedures that will be used during stormwater and sediment sampling.

3.1 FIELD LOGBOOK AND FORMS

All field activities and observations will be noted in a field logbook~~ during fieldwork~~. The field logbook will be a bound document containing individual field and sample log forms. Information will include personnel, date, time, station designation, sampler, types of samples collected, and general sample and runoff observations. Any changes that occur at the site (e.g., personnel, responsibilities, deviations from the FSP) and the reasons for these changes will be documented in the field logbook. Logbook entries will be clearly written with enough detail so that participants can reconstruct events later, if necessary. The following data will be included in the field logbook:

- General filed observations at retrieval including, but not limited to, weather conditions, presence of other activities in the area, and any factors which may affect the quality of the data.
- Date and time of sample collection.
- Names of field coordinators and person(s) collecting and logging in the samples.
- Observations made during sample collection.
- For the whole-water samples, a general description of the sample set including color, odor, and presence of an oil sheen.

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A sample collection checklist will be completed following sampling operations at each sample station. The checklist will include station designations, types of samples to be collected, and whether field replicates/duplicates, rinsate blanks, or additional sample volumes for laboratory QC analyses are to be collected. A set of field log forms is included in Appendix E.

3.2 EQUIPMENT AND SUPPLIES

Equipment and supplies will include sampling equipment, utensils, decontamination supplies, sample containers, coolers, logbooks and forms, personal protection equipment, and personal gear. Protective wear (e.g., gloves, steel-toed boots) will be worn by field personnel as specified in the Health and Safety Plan (HSP: Integral 2004b).

A detailed list of sampling equipment and supplies are listed in SOP Appendices as follows:

- Stormwater composite sampling – Appendix A

- Stormwater grab sampling – Appendix B
- Sediment sampling – Appendix C
- Flow meter measurements – Appendix D

Isco automatic samplers will be used to collect whole water samples. These samplers will be used for both composite and grab samples. For composite samples, the samplers will be operated with sequential sampling capabilities. The samplers will be programmed (see Section 3.2.1) to collect flow-proportional discrete samples. Teflon suction tubing, silicon pump tubing and glass bottles will be used in all location. Sample probes will be attached to a stainless steel plate. The plate will be bolted using concrete bolts to the bottom of the pipe. Hoses and electrical cords will be attached to the side of the pipe and manhole using concrete bolts and plastic ties. The sampler will be hung from the manhole rungs using stainless steel cable and iron hangers.

Sediment traps will be used to collect in-line sediments. The sediment traps consist of a stainless steel bracket and a glass bottle. Figure 2-2 presents a photograph of a prototype of the sediment trap that will be deployed.

The analytical laboratory will supply sample containers and preservatives, as well as coolers and packing material. Commercially available pre-cleaned jars will be used, and the laboratory will maintain a record of certification from the suppliers. The bottle shipment documentation will record batch numbers for the bottles. With this documentation, bottles can be traced to the supplier, and bottle wash analysis results can be reviewed. The bottle wash certificate documentation will be archived in the project file. Field personnel will not obstruct these stickers with sample labels.

Sample containers will be clearly labeled at the time of sampling. Labels will include the project name, sample location and number, sampler's initials, analysis to be performed, date, and time. The nomenclature used for designating field samples is described in Section 3.6.

3.2.1 Automatic Sampler Programming Protocols

Composite Sample Mode.

Grab Sample Mode.

3.2.2 Equipment Maintenance

Are samplers going to remain in the field for the duration, or will they be returned to the lab? Will maintenance occur in the field or in the lab? What happens when a sampler develops mechanical problems? How often will samplers be maintained?

Commented [NU10]: I didn't see where you discuss equipment installation. Please include somewhere – it doesn't need to be in this section. Same for sediment traps and flow meters.

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3.3 EQUIPMENT DECONTAMINATION PROCEDURES

The following is a brief description of decontamination procedures for each set of equipment. Details of these procedures are described in Appendices A, B, and C.

3.3.1 Water Sampling Equipment

All sampling equipment and containers will be prepared prior to the sampling event. Any portion of the tubing, pump, filters, and Isco sampler or other materials coming into contact with sampled stormwater will decontaminated prior to use or certified pre-cleaned from the equipment source. Appendices A and B contain detailed procedures and equipment material requirements to avoid potential contamination of samples. These procedures are summarized below.

After the equipment has been installed and used, the Isco sampler head (silicon tubing only) and Isco base will be decontaminated at the lab using the same steps, but the Teflon tubing will be left in place at the sample station and rinsed with 1 gallon of laboratory pure water between each sample event or during routine maintenance. After each sampling event, the sampler silicon pump tubing will either be replaced with a new silicon hose or a laboratory decontaminated silicone hose. In addition, the base of the sampler will be replaced after each sampling event with a different base containing sampling jars that have undergone decontamination according to the SOP in Appendix A.

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Equipment rinsate blanks will be performed by running DI (reagent grade) water through a decontaminated Teflon sampler hose, strainer and silicone pump tube installed in the sampler, into pre-cleaned sampler containers until sufficient volume is collected to run the analytes of interest (see Section ?? and Field Quality Control Procedures in Appendix A).

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The laboratories listed in Table 2-5 will provide glass containers for collecting samples. Glass containers and jars will be pre-cleaned according to laboratory SOP (see QAPP Addendum 8). Certification information is kept at the laboratory and is available for review at any time. The sample procedures are used for cleaning sampling equipment and containers for SIM analysis. The containers will be certified to the detection limits of this project (Table 2-6b).~~The top cover, center section, retaining ring, and tub of the automatic sampler will be cleaned with warm soapy water and rinsed with tap water. The two pump drain holes will be checked to see that they are open and free of debris or buildup.~~

~~The sampler intake tubes and screens will be cleaned and stored until they are deployed using the decontamination procedure in Appendices A and B. During implementation of the FSP, it is not anticipated that screens and intakes tubes will be removed for cleaning between sampling events. The sampler will be programmed to purge the intake tubes several times before and after each stormwater sample is collected, which should ensure that any contamination from previous events is removed or sufficiently diluted to be unimportant. If upon routine inspection, it is observed that algae is growing in the intake~~

~~tube, debris is blocking the tube, or any other gross contamination issues may exist, it will be replaced with a tube and screen decontaminated per Appendices A and B.~~

~~The Teledyne/Isco glass sample bottles will be sent to the analytical lab for cleaning and returned to the LWG Field Laboratory for deployment. The procedure for these bottles is described in Appendices A and B.~~

~~Mounting equipment such as slip rings, nuts and bolts, brackets will be washed with warm soap water using a brush to remove any oil, grease, or other residue from the manufacturing process. They will then be rinsed with spectro-grade acetone and then with tap water and allowed to dry. A warm oven could be used to speed drying.~~

~~When installing the brackets in the field at the sampling sites, it may be necessary to drill holes or use powder actuated tools to set studs, weld, or use other means to attach the sampling hardware that may create some debris that could become a contaminant source. After the studs are set or other procedures are complete, the work site will be scrubbed with a brush to remove any debris and rinsed with deionized water before the sampling hardware (intake screen) is mounted.~~

Commented [Andy13]: Maybe delete this text since it is covered in an appendix. If it is kept there might be consistency issues.

3.3.2 Sediment Sampling Equipment

Sediment Traps. Any portion of the sediment trap bottle, sample collection, and homogenization equipment coming into contact with sediment samples will decontaminated prior to use or certified pre-cleaned from the equipment source. Detailed decontamination procedures for sampling equipment are included in the Appendix C. ~~The following paragraphs summarize the cleaning procedures.~~

~~The sediment traps consist of a stainless steel bracket and a glass bottle. The mounting bracket, nuts and bolts, brackets will be washed with warm soap water using a brush to remove any oil, grease or other residue from the manufacturing process. They will then be rinsed with spectro-grade acetone and then with tap water and allowed to dry. A warm oven could be used to speed drying.~~

The glass sample bottles will be sent to the analytical lab for cleaning and returned to the LWG Field Laboratory for deployment or purchased and delivered as “Certified Clean.” The decontamination procedure for the bottles is also described in Appendix C.

When installing the brackets in the field at the sampling sites, it may be necessary to drill holes or use powder actuated tools to set studs, weld, or use other means to attach the sampling hardware that may create some debris that could become a contaminant source. After the studs are set or other procedures are complete, the work site will be scrubbed with a brush to remove any debris and rinsed with deionized water before the sampling hardware (sample bottle holder) is mounted.

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Water Filtering for Sediment Collection (Back up Procedure). Any portion of the tubing, pump, filters, or other materials coming into contact with sampled stormwater will decontaminated prior to use or certified pre-cleaned from the equipment source. Detailed decontamination procedures for sampling equipment are included in Appendix C.

3.4 STORMWATER SAMPLE COLLECTION PROCEDURES

Stormwater collection procedures are described in detail in Appendices A and B. Two methods of stormwater collection will be used:

- Flow weighted composite sampling of organics, metals, and conventionals that will be collected using an automated Isco pump and sample container system and Teflon™ tubing (Appendix A).
- Grab water sampling of organics and conventionals using Isco pump, sample containers, and Teflon tubing (Appendix B).

The appendix SOPs for stormwater sampling follow the general concepts used in the sampling and analysis of trace metals in relatively clean surface waters. Examples, of these procedures are in EPA's Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels* (EPA 1996), and by the *Field Sampling Manual for the Regional Monitoring Program for Trace Substances* (David et al. 2001). These methods use the "clean hand-dirty hand" (or CH/DH) approach to sample collection. Because this sampling effort does not involve sampling trace levels of chemicals in relatively clean surface waters there is no need for a strict CH/DH procedure. However, the general concept of separating equipment and sample handling jobs to minimize the potential for contamination of samples is employed throughout the SOPs. Detailed procedures for each type of sample collection that follow this general concept are described in Appendices A and B.

3.4.1 Summary of Composite Stormwater Sampling Methods

Stormwater samples for standard chemical and conventional analyses will be collected using a peristaltic pump through a Teflon-lined intake tube with a Teflon coated stainless steel pickup screen. The tube and screen will be attached to the bottom of the junction outlet along with the Area Velocity (AV) flow sensor (described more below). The pre-cleaned Isco sampler (following procedures discussed above) will be delivered to the sample site by the sampling team.

Whereever possible, the sampler will be located above ground and next to the junction selected for sampling. The pick up screen and the AV flow sensor will be installed on the sensor carrier that is installed when the sediment traps are installed. Although there are tools that allow surface installation of sensors, confined space entry may be required to install the pickup screen and flow sensor. In addition, at some locations accessible to the public (e.g., manholes on streets), the actual sampler will be installed within the junction

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selected for sampling. If confined space entry is required for any location, it will follow procedures in the HSP Addendum (Appendix H).

After the pickup and sensor have been installed, the sampler will be powered up and allowed to go through the self check process. If the sampler check is acceptable, the sample bottles will be installed. Once the bottle section of the sampler is closed, the sampler will be enabled. The sampler will then be lowered into the junction, if necessary, or otherwise secured above ground on the site. Care will be taken not to pinch or kink the pick up tube of the flow sensor cable.

Once the sampler is deployed and the cover is closed, the sampling team leader, or designate, will call the sampler to disable it until an appropriate storm is forecasted. The automatic sampler, when enabled, will be programmed to initiate sampling once specified trigger conditions (e.g., flow depth and/or volume) have been met and will continue to sample until the conditions are no longer met within the 24-hour sampling duration or the bottle capacity is reached. The trigger conditions will be different for each sampling station due to differences in basin sizes, pipe/junction configurations, and runoff characteristics, as well as non-stormwater discharges such as base flow.

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The sampler will collect flow weighted samples into seven 1.8-liter glass bottles. The sampler will be programmed to collect flow proportional sample volumes. Samples will collected on a uniform time basis and the volume collected at each time step will be proportional to the volume of water that has passed the flow meter since the previous time step. The sampler collects the stormwater in 10-ml increments. The number of 10-ml increments collected at each time step is dependent on the flow rate and the sampler programming that is unique to each sampling site. The volume of stormwater water that passes the flow module per 10-ml sample increment will be estimated for each basin to maximize the likelihood that the minimum volume of water required for analysis is collected without exceeding the total bottle volume capacity of the sampler.

The samplers will be programmed with several sample routines that will vary the sample size based on the anticipated rainfall. The minimum volume collected will be based on the minimum storm expected to generate runoff (0.2 inches). The maximum volume will be based on the forecasted precipitation with some allowance for under-predictions of rainfall associated with a storm.

It is possible during a given event that not all the sample bottles are filled or that the bottle volume is exceeded due to differences between the forecasted precipitation and the actual precipitation at the site. The flow data collected at the time of sample collection will be examined to determine if the sample appears to be valid or needs special compositing considerations (as described below) before compositing and shipment to the analytical lab.

After the sampling event, the sampling team leader will call the sampler and disable it if the storm event concludes prior to the 24-hour cutoff, to prevent additional stormwater from being collected. The sampling team will retrieve the automatic sampler and remove sample bottles and seal them with Teflon lined caps, label, and package them appropriately for transportation to the LWG Field Laboratory. The sampling team will install new bottles and re-deploy the sampler as described previously. The Isco samplers will be decontaminated prior to the first installation and will not be subsequently decontaminated except as noted above and in Appendix A.

At the LWG Field Laboratory, the sampling team will combine the samples into a single composite and samples will be filtered (for metals analyses only) and prepared for laboratory analyses. The compositing, filtering, and sample preservation will occur at the Field Laboratory as soon as possible after sample collection. The goal will be to conduct filtering within 24 hours of sample retrieval from the samplers. Field filtering procedures for metals are described in detail in Appendix A. Throughout this process, the samples will be handled following the procedures described in the Chain of Custody SOP (Appendix F).

As part of the field sampling procedures, the sampling team will download the sampling report and flow data from the data logger. The field collected samples will be transported to the LWG Field Laboratory and left in their respective coolers, or refrigerated, until the sampling report and flow data can be reviewed. If the sampling report and flow data indicate that there was no malfunction and all the sample bottles are intact, the compositing and sample preparation would continue as described in Appendix A. The samples would be emptied into a large sample container and mixed (i.e. using a churn splitter or other suitable apparatus) while samples are distributed to sample bottles for laboratory analyses.

Several problems could occur that may affect the viability of a sample collected. Common potential problems and contingencies are as follows.

1. Sample volume is not adequate to do all of desired analyses. This may occur when the forecasted precipitation is substantially greater than the actual site precipitation. Under these sampling conditions, the sample will be composited as normal and samples for analyses will be prepared in the priority shown in Table 2-3.

2. Sample exceeds bottle capacity. The sampler report indicates that the bottle capacity was exceeded. This may occur when the forecasted precipitation is substantially less than the actual site precipitation. In this case the flow data will be evaluated; if the collected samples represent 50 percent or greater of the total storm and encompasses some of the falling limb of the storm, the total volume will be composited and analyzed per normal procedure. If the sample volume represents less than 50 percent of the total storm volume, it should be composited and held at the LWG Field Laboratory under conditions shown in Table 3-2 for possible later analyses in the event that no further storm events can be successfully captured.

3. A portion of the sample is lost. This would occur when one or more of the sampling bottles was damaged or the sampler malfunctioned. In this situation, the sampling report and flow data will be reviewed to determine what representative portion of the storm volume is missing. In this situation, it may be possible that a significant portion of the storm was not sampled, and/or there is not adequate volume to complete the desired analyses. Following the process of the two previous scenarios, if the sample includes sample that represents 50 percent of the storm and both rising and falling limb conditions are included, then the sample will be used. If not, it will be archived at the Field Laboratory as described above. If the sample meets the above conditions but the volume is inadequate to conduct all analyses, the sample containers will be filled in the priority order of analyses shown in Table 2-3.

3.4.2 Summary of Grab Stormwater Sampling Methods

Stormwater grab samples for standard chemical and conventional analyses will be collected using a peristaltic pump that is part of the Isco automatic sampler. The Isco sampler will be removed from the sampling location by the sampling team. The sampler case will be opened and the delivery tube will be removed from the bulk head fitting. A Teflon lined tube will be connected to the bulkhead fitting to collect the desired samples. The sampler will be put into "Grab" mode and the specified volume will be programmed into the sampler. Once activated, the sampler will purge and the grab sample will be collected into four 1-gallon jars.

The sampling team will seal the samples with Teflon lined caps, label, and package them appropriately for transportation to the LWG Field Laboratory. The sampling team will remove the grab sampling tube from the bulkhead fitting and reconnect the distribution tube and close up the sampler. The sampling team will re-deploy the sampler as described previously.

At the LWG Field Laboratory, the sampling team will combine the samples into a single composite for each event and samples will be filtered and prepared for laboratory analyses. The compositing, filtering, and sample preservation will occur at the Field Laboratory as soon as possible after sample collection. The goal will be to conduct filtering within 24 hours of sample retrieval from the samplers. Field filtering procedures for organic compounds are described in detail in Appendix B. The samples shall be handled following the procedures described in the Chain of Custody SOP (Appendix F).

3.4.3 Flow and Rain Data Collection

Flow will be measured with the Teledyne/Isco 750 AV Module (module). The module is an add-on enhancement to the Teledyne/Isco's 6700 Series Samplers that are being used to collect stormwater samples. The module provides the ability to collect flow proportional sample volumes and flow-paced samples. The sampler displays the realtime level, velocity, flow rate, and total flow provided by the module. The sampler records this data for later analysis.

The module is designed to measure flow in open channels without a primary device. (A primary device is a hydraulic structure, such as a weir or a flume, which modifies a channel so there is a known relationship between the liquid level and the flow rate.) Area velocity flow conversion requires three measurements: water level, velocity, and pipe dimensions. The AV sensor provides the level and velocity measurements. The pipe dimensions will be measured in the field and entered during module programming. The flow calculation is made in two steps. First, the module calculates the pipe cross-section (or area) using the programmed pipe dimensions and the level measurement. Then, the module multiplies the channel cross section and the velocity measurement to calculate the flow rate.

The sampler will be programmed to use the customary U.S. measurement units, such as feet (depth), cubic feet per second or gallons per minute (flow, depending on size of the contributing basin), and gallons or millions of gallons (volume, depending on the size of the contributing basin). The sampler will be programmed to record flow data at 5-minute intervals. These data will be periodically downloaded throughout the course of the sampler deployment (as determined by data storage capacity) and entered into the project database.

In addition, data on rainfall will be obtained from various existing established rain gauge stations around the Portland area. These data will be used to make sampling decisions throughout the course of the sampling and to understand flow results for data reporting.

3.5 SEDIMENT SAMPLE COLLECTION PROCEDURES

Collection procedures for stormwater sediments are detailed in Appendix C and summarized below.

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3.5.1 Sediment Traps

As described in Section 2.3, sediment traps will be deployed at each location for a minimum target period of 3 months. Sediment traps will be inspected on a monthly basis at a minimum. When inspected, if the collection bottle is half full, sediments will be collected and archived and a clean bottle, filled with deionized water (to prevent floating) will be returned to the trap. This process will be repeated, and sampled sediments archived at the LWG Field Laboratory for additional later compositing until the trap deployment period ends.

Sediment samples will be capped with Teflon lined lids, labeled, sealed and packaged appropriately for transport to the LWG Field Laboratory. At the field laboratory, the samples will be removed from the sampler bottles and stored in wide-mouth jars in the freezer.

Sediment removal from the sample bottles will require several steps as the bottle opening is approximately 1/2 inch in diameter. The sampling technician will decant most of the water from each sample bottle into a decontaminated flask. The technician will then swirl or stir the remaining water with a decontaminated stainless steel implement to mobilize the sediments. The technician will then pour the slurry into a decontaminated funnel with 2-5 micron filter paper and allow the leachate to drain to a decontaminated flask. Once the sediment has drained to a consistency allowing homogenization with a stainless steel spoon, the sample can be lifted out by the filter material and placed into the decontaminated storage jar. The leachate water and the decanted water then can be used to rinse the sample bottle and remove the last of the sediments. Once all the sample bottles have been emptied and the sediments have been added to the storage jar, a stainless steel spoon can be used to scrape off any sediments that have adhered to the filter material into the storage jar. The leachate water or decanted water can be used to rinse the filter material or add moisture if needed.

At the end of the deployment period, the collection bottles will be capped with screw closures, removed from the mounting brackets, packaged and placed on ice in coolers for transport to the laboratory (see Table 2-5). The samples will be cooled with ice/blue ice that is enclosed in a second plastic bag to prevent contact and possible contamination from the ice (tap water). Processing will begin as soon as possible after each sample is retrieved. At the laboratory, all sediments for each location will be combined and homogenized using stainless steel utensils. These utensils will be cleaned prior to use in accordance with the laboratory SOP.

~~Once the deployment period has ended, all sampled sediments (including archived aliquots) will be combined in one decontaminated stainless steel bowl using decontaminated stainless steel implements and thoroughly homogenized and subsampled in sample containers for chemical analyses.~~

Sample analysis containers will be filled in the priority order shown in Table 2-3, except for the alternate priority for some locations as described in Section 2.3, until the bowl is empty.

3.5.2 Water Filtering for Sediment Collection (Back up Procedure)

This procedure will be used in the event that a sediment trap cannot be deployed at a location because of limited space availability or other logistical reasons. To mimic the deployment of sediment traps, this procedure would be employed over several storm events at the location in question. The sediment samples obtained over several events will then be composited in the analytical laboratory to mimic the deployment of a sediment trap over 3 months.

Large volumes of water will be pumped through Teflon™ tubing to collect the particulate fraction from the water for subsequent analysis of the particulate fraction. Currently, two techniques are being evaluated as options for sediment collection: collection with a portable continuous flow centrifuge pump; and collection with a peristaltic pump system with sequential filters and glass fiber filter cartridges. The total volume of water pumped for each sample will be determined based on the analytes selected for the station. Table 3-1 provides estimates of stormwater sample volumes required for each of these sample collection techniques

The portable continuous flow centrifuge pump system samples would be collected by pumping water from the sample location (junction) and sequestering the suspended particles in sample collection jar, which would avoid collecting and retaining large volumes of water for subsequent filtration. The accumulated sediment would then be transferred from the centrifuge pump sample collection vessel, homogenized, and subsampled into sample jars for chemical analysis. The peristaltic pump system would require a high pressure tubing setup and large volume capacity filters, in series, to extract the suspended particles. The large capacity filters would be connected in series with the smallest pore size of 4 or 5 µm, which is the low-end range for silt particles (ASTM 1985). The peristaltic system could be conducted by collection of water into a container (e.g., 20L carboy) and subsequent filtration. The reconnaissance survey will help determine whether the high-volume collection could be conducted directly from the sampling location without intermediate storage. The minimum filter pore size to be used will be 4-5 µm.

Samples will be collected using the using methods that minimize the potential for contamination through sample or sample equipment handling and will follow the general concept of the CH-DH approach described above. Once the desired volume is pumped, the glass fiber filters will be removed, placed in sample jars, and stored in a cooler containing wet ice. At the analytical laboratory, the filters will be archived until the last sampling event is conducted. Once filters from the last event arrive in the laboratory, the laboratory technicians will combine the sediments from all the filters at each location and homogenize using clean implements. The resulting homogenized sediment sample will be analyzed to determine the concentration of chemicals present within the collected particulates. Detailed procedures for this sampling technique are described in Appendix C.

3.6 SAMPLE IDENTIFICATION

All samples will be assigned a unique identification number based on a sample designation scheme designed to meet the needs of the field personnel, laboratory and LWG data management, validation chemists, and data users. The unique code will be assigned to each sample as part of the data record and will indicate the project phase, sampling location, sample type, sampling event, and level of replication/duplication. Sample identifiers will consist of two to three components separated by dashes. The first component, LW3, identifies the data as belonging to the Lower Willamette River RI/FS as a part of the Round 3 sampling. The second component will begin with the abbreviation “STW” to designate the stormwater sample, followed by a CW, GW, or S for composite water, grab water, or sediment, followed by a single-number code that designates the sampling event. The station number will complete the second component.

Additional codes may be adopted, if necessary, to reflect sampling equipment requirements. Leading zeros will be used for stations with numbers below 100 for ease of data management and correct sorting. The third component will be used to code field duplicate and replicate samples. A single digit number will be used to indicate field duplicates or splits in the third component of the sample identifiers. For equipment decontamination blanks, sequential numbers starting at 900 will be assigned instead of station numbers. The sample type code will correspond to the sample type for which the decontamination blank was collected.

Example sample identifiers are:

- LW2-STW-CW-1022: stormwater composite sample from Station 22 collected during the first sampling event.
- LW2-SW-CW-1022-1: stormwater composite sample from Station 22 collected during the first sampling event; field duplicate is associated with this sample.
- LW2-SW-CW-1022-2: field duplicate stormwater composite sample from Station 22 collected during first sampling event.

3.7 SAMPLE HANDLING AND STORAGE

The number, size, and type of sample containers needed for each sample are listed in Table 3-2. This table also includes the preservative and holding times for the various analyses. In general, preservatives will be added to the sample containers by the analytical laboratory prior to shipment to the field. The sampling team will confirm the presence or absence of preservative in the containers prior to filling. Any discrepancies with preservatives will be noted on the field sampling records, and corrective action will be initiated.

Once the sample is collected and preserved, the sample container will be capped, labeled, and placed in double-sealed polyethylene bags and stored on ice or refrigerated until shipped to the laboratory under the chain-of-custody procedures outlined in Appendix F.

Each storage freezer or refrigeration unit in the LWG Field Laboratory will be monitored bi-weekly to ensure temperature compliance. Each unit will have a separate log form containing date, time, and temperature information.

3.8 QA/QC

3.8.1 Field Quality Control

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Field QC samples are used to assess sample method variability (e.g., replicates) and sample variability (e.g., duplicates), evaluate potential sources of contamination (e.g., equipment rinsate and trip blanks), or confirm proper storage conditions (e.g., temperature blanks). The estimated numbers of field and QC samples are listed in Table 2-2. Details on field replicate samples and field QC samples are described in the QAPP Addendum.

In summary, the QAPP Addendum describes QA/QC procedures that will be used to complete the stormwater investigation. The QAPP Addendum for the stormwater investigation was developed within the framework of the existing LWG Round 2 QAPP (Integral and Windward 2004) and Addenda (Integral 2004a) for the ongoing LWG investigations.

For sediment trap samples, the mass of material collected is anticipated to be limited. For sediment samples, the QAPP Addendum includes the collection of field QC samples and additional mass for laboratory QC samples (matrix spike, matrix spike duplicate or laboratory duplicate) as follows and per Table 2-2:

- Field replicate, 1 per 20 samples
- Laboratory QC samples, 1 per 20 samples
- Equipment rinsate blank for phthalates, 1 per 20 samples

Field replicates will be generated by deploying sediment traps with additional sample collection vessels, and compositing the sediment from each half of the sediment trap collection vessels, separately, into two subsamples for analysis. Deployment of two vessels will only be possible at some of the locations, due to expected space limitations within the junctions. Consequently, after the location reconnaissance, the locations of the replicate trap deployment will be determined based on available space and other constraints noted above for sediment trap deployment. Replicate trap deployment will be conducted at sufficient locations to meet the 1 in 20 requirement. If this is not possible, the replicate analysis will be substituted with a duplicate analysis consisting of homogenizing sediment from one vessel and splitting into two equal aliquots for analyses, at locations where sufficient volume is present, so that the 1 in 20 requirement. Analysis for laboratory QC samples will be conducted by dividing the total sediment collected from one sediment trap vessel at select locations with sufficient volume into three aliquots of equal mass for the laboratory analysis of the sample, matrix spike, and matrix spike duplicate.

For water samples, the sampling program will be designed to collect additional volume for field and laboratory QC samples. The QC program for water samples includes:

- Field duplicates, 1 per 20 samples
- Laboratory QC samples, 1 per 20 samples
- Equipment rinsate blank for all analyte groups, 1 per 20 samples.

The inclusion of phthalates in the analyte list requires careful consideration in the design of the sample collection program to ensure that the sediment and water samples do not come into contact with phthalate-containing material. Because the water samples require pumping and additional handling for compositing, the likelihood of field contamination from contact with phthalate-containing components increases and could result in qualification of the data if phthalates are detected in the associated field blank samples. The procedures detailed in Appendices A, B, and C include careful consideration of the materials and handling procedures used in order to avoid such sampling contamination if at all possible.

It is likely that the samplers may be deployed with open bottles for several weeks before a storm sample is collected. Airborne deposition of chemicals from the sampler bodies, which are made from various plastic materials, or ambient atmospheric urban sources may be potential source of contamination to the open bottles. Consequently, the bottle eventually used for the rinsate blanks will also be left un-capped inside the samplers during sampler deployment and will be handled identically to the actual samples during the sample collection process.

3.8.2 Laboratory Quality Control

Standard Qulaity Control procedures used by the laboratories listed in Table 2-5 will be used for this project as document in each laboratory's SOPs in the QAPP. At a minimum, laboratory quality control samples will include analysis of surrogates, replicates, duplicates, laboratory control samples, method blanks matrix spike and matrix spikes duplicates in each batch of samples where appropriate. Specific recommendations for QC samples and control limits are listed in Tables 4-1 and 4-2 and in the laboratory's QA manual or the method being used (see specific analytical method in the QA Manual for Round 2).

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4.0 SAMPLING IMPLEMENTATION AND SCHEDULE

4.1 SAMPLING TEAMS AND ORGANIZATION

Successful completion of the sampling and analysis requires coordination and adherence to the FSP and QA/QC procedures. Staffing and responsibilities are outlined below; an organization chart is provided in Figure 4-1. The following discussion briefly outlines the duties of the key participants. The LWG will notify the Agencies if there are any changes in the project organization listed below.

4.1.1 Project Planning and Coordination

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~~In order to implement the stormwater sampling program, a team approach has been developed to prepare the FSP, install and maintain sampling equipment, collect samples and deliver them to the laboratory, and finally report the data.~~ As shown on the organization chart (Figure 4-1) Anchor has the lead role in implementing the FSP. ~~The following discussion briefly outlines the duties of the key participants.~~

~~Mr.~~Carl Stivers will act as the overall Anchor project manager. As the manager, he will act as the ~~key~~ primary contact to the Portland Harbor technical and management teams. ~~In addition, Mr. Stivers played a key role in the development of the monitoring strategies, selection of monitoring sites, identifying the constituents to be monitored, and ensuring the FSP meets the overall study objectives noted in Section 1.~~

4.1.2 Field Sample Collection

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~~Mr.~~Simon Page, Anchor Environmental, is overseeing the field program ~~and is the lead author of the FSP~~. Mr. Page~~He~~ will participate in the station reconnaissance and preparation, described in ~~the following s~~Section 4.2. He will direct the sampling teams when to activate the automatic samplers, equipment installation, assist in troubleshooting equipment problems, and be available to act as an alternate on the sampling teams.

The sampling teams will be lead by an Anchor water quality specialist familiar with the equipment operation. Each team will also have a specialist from Integral to oversee the collection, processing, and shipment of the samples to the laboratory. The team leader will have the responsibility to deploy and redeploy their automatic samplers as needed, activate their automatic samplers when notified of a storm meeting the sampling criteria is imminent, conduct collection the samples in a timely manner, download sampler storm event data, conduct or coordinate delivery of the samples to the LWG Field Laboratory, coordinate delivery of samples to the analytical laboratories, filling out all field forms and chain of custody forms, and ensure that all field work is conducted in accordance to the HSP (Integral 2004b).

The operations and maintenance team will be based in Portland and have responsibility to routinely inspect and repair the sediment traps, Isco samplers, and other equipment, calibrate flow meters and samplers as needed, download the flow data loggers, and rotate the batteries in the automatic samplers to ensure that they are ready at all times to initiate sampling. They may also deliver samples to the LWG Field Laboratory as needed.

The Field Laboratory Team will assist in the processing, tracking, and archiving of samples, maintain sample archives, conduct packing of coolers and filling out chain-of-custody forms for laboratory delivery, will coordinate with the laboratories for sample delivery and/or pickup, facilitate the tracking of samples, and coordinate with laboratories to ensure correct analyses following the QAPP addendum are conducted.

The laboratories used for the sampling program are listed in Table 2-5. The laboratories will be responsible for providing "certified clean" sample bottles and equipment to the sampling teams, coolers and packaging materials, labels, seals, and chain-of-custody forms. The laboratories will designate a project coordinator who will be responsible for receiving the samples from the field laboratory team and coordination of data reporting. The laboratory coordinator will also be responsible to ensure that the samples are analyzed according to the specified methodologies.

4.1.3 Chemical Analysis

The laboratories used for the sampling program are listed in Table 2-5. The samples will be analyzed for the analytes listed in Section _____ and Tables _________. The laboratory coordinator will also be responsible to ensure that the samples are analyzed according to the specified methodologies.

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4.1.4 Laboratory QA/QC Management

Name, Affiliation, will perform the QA/QC review of the data and produce the Quality Assurance Data Summary Package. *Name, Affiliation*, will provide final review of the Quality Assurance Data Summary Package, and will serve as the overall Quality Assurance Manager for the Project.

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4.1.5 Data Management and Analysis

Name, Affiliation, will supervise data management and statistical analysis of hydrologic, stormwater and in-line sediment data. *Name, Affiliation*, will provide oversight and final review of the technical evaluations.

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4.1.6 Final Report

Name, Affiliation, will be responsible for assembling the Final Report describing sample locations; sampling, handling, and analytical methods; data reports including QA/QC

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chemistry and data validation, database management, statistical evaluations, and an evaluation of data results.

4.2 STATION RECONNAISSANCE AND PREPARATION

Sample locations will be verified during a reconnaissance visit consisting of the sampling team leader for those sample locations and persons knowledgeable with the particular location in question. Conditions encountered in the field during implementation of this FSP may result in modifications to the sampling design at some or all locations. The Stormwater Technical Team will be made aware of the conditions and will approve substantial location-specific modifications to the FSP.

During the reconnaissance survey, the teams will identify the targeted discharge point and inspect the site to identify the location where the equipment can be installed to meet the sampling objectives. At each site, the team will locate the junction or structure nearest the outfall where the equipment may be installed. At these locations, the team will:

- Attempt to determine the sampling location elevation from the site map as well as measuring down to the invert of the junction outlet and comparing known or measured relative elevations to observed elevations of shoreline features such as the limit of permanent vegetation (which is often approximately equivalent to ordinary high water mark within the Portland Harbor area)
- Verify that flow conditions are conducive to flow-paced sampling (e.g., orientation of incoming laterals, debris)
- Verify that there is space available within or adjacent to the site to secure the Isco automatic sampler
- Verify that there is space available to install the sediment trap and/or replicate traps for some locations
- Measure outlet pipe size to order or fabricate the appropriate mounting brackets for the sampler pick up tube, flow meter sensor, and the sediment trap.

The primary purpose of determining the sampling location elevation will be to determine whether back up of river water into the junction or adjoining pipes is reasonably likely. Such a condition will be avoided to prevent sampling of river water instead of, or in combination with, stormwater. Table 4-1 presents statistics on river heights based on USGS data from the Morrison Street Bridge gauge for the proposed months of sampling. This gauge is located 2.9 feet above City of Portland datum (i.e., add a value of 2.9 to the Morrison Street Bridge gauge height to obtain a value in City of Portland datum). As shown in Table 4-2, the upper range (i.e., above 80^{th} percentile) statistics on the average monthly river height in this period is in the range of 10 to 14 feet as measured by the gauge. Because a monthly average does not explicitly capture daily highs that may have occurred within any given period, the daily 90^{th} percentile statistics are also presented. The upper range (i.e., above 80^{th} percentile) statistics on these values range from 11.9 to 17 feet in this period, as measured by the gauge.

No specific criteria for acceptable junction elevation are proposed here. Rather, the field reconnaissance information for each location (and potential alternate locations) should be compared to Table 4-2 to determine the relative likelihood of river backup at any particular location. The field crews will make determinations in coordination with the Stormwater Technical Team of acceptable levels of risk for river backup at each sampling location. These decisions will also consider other factors such as the relative feasibility of moving to a nearby location (i.e., within the same basin) and the availability of any other alternate locations (i.e., in other basins entirely) that might also meet the objectives of the location in question. For example, where few if any nearby or alternative sampling locations exist that meet the intended objectives of the sampling location, then acceptance of a greater risk of river backup at a particular location may be warranted. Conversely, if an alternate location that meets all the location objectives can easily be found, there should be a relatively low tolerance for the potential of river backup at a given location.

Where the junction elevation of a particular location appears to have a reasonable potential for river backup based on the field reconnaissance information, more accurate surveys of the location elevation may be warranted and will be conducted as necessary to reach decisions consistent with the above framework.

Another key measurement that will be needed is the depth of the junction structure below the invert of the outlet. Ideally, sediment traps will be mounted adjacent to the outlet with the opening of the sampling bottle at the same elevation of the invert. If the bottle is located higher, it may not effectively collect the heavier fractions of the sediment or may introduce excessive turbulence that interferes with the function of the flow meter. In some situations, this ideal location may not be possible and alternate locations within the junction structure that would be expected to still capture substantial amounts of sediments and avoid excessive turbulence may need to be evaluated and determined.

In addition, the team will attempt to identify any non-stormwater flows that could enter the conveyance during the sampling period (e.g., groundwater, stream flows, sheet flow from adjacent sites, batch discharges). Depending on the source, the location-specific procedures may need to include collection of information on the nature, amount, and timing of those flows.

If the targeted sampling location is not adequate, the team will move upstream to the next available representative structure for evaluation. Anchor will report the identified sampling locations to the Stormwater Technical Team for approval. It is possible that a suitable monitoring station cannot be found and an alternative outfall will be needed to be selected to meet the study goals, see Section 4.3 for a discussion of the contingency process for selecting and alternative sampling location

4.3 BACKUP AND CONTINGENCY PROCESS FOR LOCATION SELECTION AND SAMPLING

If it is determined that a sediment trap or automated water sampler deployment is infeasible for the selected basin, or that available sampling locations within that basin will not meet location objectives (i.e., are not representative of targeted land uses or site activities), several alternatives may be implemented.

4.3.1 Land Use Based Sampling Sites

If it is a land use based sampling site, another representative outfall or basin could be selected; alternately, another location within the basin could be selected, as long as the remaining basin area is still representative of that land use. Based on the identification of a physically suitable site by the reconnaissance team, as described previously, the site will be re-evaluated in the office. The selected location will be first compared to the infrastructure maps to determine what areas will be captured by the sampling location. The land uses in the captured area will be evaluated to determine if they meet the sampling goal.

If the revised basin does not meet the land use selection criteria an alternative outfall will be selected and a reconnaissance survey will be conducted to determine if the equipment can be installed.

Time is of the essence to collect the stormwater samples in the 2006/2007 rainy season. From that perspective, selecting a truncated area of the original basin would be superior if the remaining area provided the land use characteristics desired. Deciding to look for an alternative basin and investigating it may result in not getting the desired number of water quality samples or the desired volume of sediment. However, because all the equipment will not be delivered and installed simultaneously, there may be a 2-week period during which an alternative site can be selected and approved by the Stormwater Technical Team without greatly affecting the implementation of the FSP.

If the primary issue is that a sediment trap cannot be installed, the high volume water filtering alternate technique could be employed at these sites without need for moving to alternate locations.

4.3.2 Industrial Sampling Sites

If it is not feasible to install the sampling equipment at an industrial sampling site, the same procedure described above for land use-based sites would be employed by moving the pipe up or to another site drainage basin to see if another sampling point that drains most of the desired site can be found. If such an on-site alternate location cannot be found, it may or may not be feasible to select another industrial site to fulfill the role of the desired site. Any such proposals to move sites would be closely coordinated with the Stormwater Technical Team to obtain approval.

It is difficult to speculate what problems may occur and what the solutions may be without the basic reconnaissance of the sites completed. Consequently, we do not attempt to discuss alternate procedures for all potential situations. In general, if an Isco sampler cannot be installed for any reason and selection of an alternate site is not acceptable, the alternate approach of manually collecting discrete or manual composites could be considered. If a sediment trap cannot be installed, high volume filtered sampling could be conducted.

4.3.3 Inadequate Sediment Collection

The sediment generation rate varies by land use, topography, implementation of best management practices (BMPs), and rainfall intensity. A well swept, nearly level, industrial area may not generate a significant quantity of sediment. Low intensity storms may not detach and mobilize sediments. Further, sediment traps may not collect sediments from low flow storm events. Consequently, if the collection bottle is less than one-third full at the first monthly inspection, the rainfall records will be evaluated to determine if there were storms likely to generate runoff, the sampler will be inspected to ensure that it was installed properly, the junction will be inspected to see if it is accumulating sediment, and the contributing basin will be visually surveyed to see if sediment is available to wash off. Based on the findings, it may be recommended that the sediment trap be repositioned or relocated to obtain better collection rate, additional bottles deployed, or that another sampling method be employed. An alternative sediment sampling method would be high volume filtered samples.

4.4 SITE SPECIFIC SAMPLING REPORTS

Site specific sampling reports will be developed for the F~~f~~ield ~~s~~Sampling R~~r~~eport (described in Section 5) based on the field reconnaissance surveys and decisions made in coordination with the Stormwater Technical Team. A description of each sampling site will be developed for the report that describes the specific details for implementation of this FSP at the each site. The specific details of the report will include:

1. Figure showing the drainage basin and actual sampling location within the basin.

2. The reconnaissance survey datasheets, notes, and photographs as necessary to describe the situation.

3. Diagram of sample equipment set up within the specific site pipe or junction noting key dimensions.

4. Photographs of the installation.
5. Calculations of estimated runoff quantity and responses for various ranges of storms for sampler programming.
6. Key parameters for sampler programming (i.e., number and size of bottles, sampling rate for various storm totals, trigger conditions, length of pickup tube, etc.).
7. Sample team leader responsible for sampler.
8. Sampler telephone number.
9. Any site specific considerations that will result in deviations from the FSP standard procedures.
10. Descriptions of any planned deviations from detailed procedures in this FSP including appendices that will be applied to this site.
11. Alternate or contingency procedures (as discussed above) that are proposed for that site.

4.5 PROJECT SCHEDULE

The actual start dates for the sampling will be determined following EPA approval of this Stormwater FSP. Other conditions that may affect the sampling schedule are weather and equipment conditions and availability. Currently, it is anticipated that the stormwater and sediment samples will be begin to be collected in late February through early March. Figure 4-2 shows the currently projected schedule. The most critical item beyond EPA approval is the acquisition and deployment of the water samplers. There is a 3 to 6 week lead time to acquire all the equipment. It is anticipated that each sampling crew will be able to install two sampling kits per day. Consequently, it will take approximately 4 to 7 weeks to deploy the first sampler from the time that it is ordered and approximately 8 weeks from the time the samplers are ordered for all of them to be deployed.

The automated samplers will be activated as soon as they are installed to record flow rates and will be enabled to collect samples during the first storm event that exceeds the predetermined precipitation conditions. The sediment traps will also begin functioning as soon as they are installed. While flow is present in the stormwater system the samplers will be trapping sediments. Based on the weather forecasts and anticipated precipitation, sampling teams will be notified to enable the samplers and deployed to collect samples during following the storm events. Additionally, the sampling teams will be deployed based on forecasted weather to collect grab samples from selected locations.

5.0 REPORTING

5.1 LABORATORY AND CHEMICAL DATA

Preliminary data obtained from the laboratory will be validated following the QAPP and QAPP Addendum procedures. These data will then be entered into the LWG database including any laboratory or validation assigned qualifiers. Validated analytical laboratory data from the LWG database will be provided to EPA in an electronic format within 90 days of completion of each sampling event. A sampling event will generally be considered complete when the last sample of that type described in this FSP has been collected.

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5.2 FIELD MEASUREMENT DATA

Results of field parameters (e.g., pH) and flow data measurements at each location will be provided to EPA on schedule with and as a part of the Stormwater Site Characterization Summary Report described in Section 5.3. Field parameters will be validated consistent with the QAPP and QAPP Addendum procedures. Flow data results will be compiled into a separate project database. Rainfall data from publicly available area rain gauges will also be obtained and entered into the flow database.

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Initially, these data will be reviewed against information obtained on the flow conditions and monitoring history at each site (e.g., structure and sensor placement issues, the presence of base flows, periods of known equipment malfunction) to identify and flag any periods of questionable or censored data. Data will also be reviewed for any questionable data in periods not associated with any of the above known issues and flagged accordingly (e.g., periods of very high recorded flow with no rainfall, highly erratic readings in small periods of time, periods of no flow during high intensity rain fall, etc.). Periods associated with chemistry sample collection will be identified and flagged within the database as well.

5.3 REPORTING

A Field Sampling Report will be prepared and submitted to EPA within ~~60~~ 120 days of completing all stormwater and sediment field sample collection efforts described in this FSP. The Field Sampling Report will summarize field sampling activities, including sampling locations (i.e., information described in Section 4.4), requested sample analyses, sample collection methods, and any deviations from the FSP. At a minimum, the following will be included in the field report:

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- Description of each sampling event including date, time, antecendent and rainfall data, river stage (as measured by ?? gauge), storm duration (water samples only).

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- Comparison to rainfall event goals (water samples only).
- Description of sample collection and compositing at each location: plot of flow hydrograph and aliquot number subsample collection time, river stage, identify total number and which subsamples were composited, and Isco sampler program settings/sample results reports.
- Comparison to sampling criteria (water samples only).
- Description of each sampling event including dates if installation and retrieval and total rainfall during that period (sediment trap only)
- Field observations.
- Deviation of Field procedures.

Stormwater and sediment chemistry results, field measurements, and storm flow data will be reported in tabular format in a Stormwater Site Characterization Summary Report that will be submitted to EPA within 120 days of completing sampling and analysis for all stormwater activities. The report will also include summaries of weather conditions (e.g., field observations), field observations associated with each location inspection and/or sampling event, and rain gauge data throughout the sampled period. Preliminary data evaluations relevant to the objectives of the study also will be included in the Stormwater Site Characterization Summary Report. However, the report will not include annualized loading estimates for use in modeling evaluations. This information will be developed and reported within the framework of the overall fate and transport modeling and data evaluations for the RI/FS.

6.0 REFERENCES

Commented [NU27]: Need to include references to Rational document and QAPP Addendum 8.

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